CLAIMS

1. A hydrometallurgical process for the treatment of steel mill electric arc furnace (EAF) dust containing agglomerates of small ferrite particles and larger magnetite particles, the ferrite particles coating by adsorption the larger magnetite particles, the dust further containing calcium oxide, zinc oxide and a toxic amount of leachable lead together with minor elements selected from the group consisting of Mg, Cr, Cu, Cd, V, and chlorides, the process comprising the steps of:

a) washing the EAF dust in water to dissolve soluble salts, metals and simple oxides contained in the dust, said washing step being performed under agitation and with an alkaline pH;

b) decanting the solution of step a) to obtain a supernatant liquid containing the dissolved salts, metals and simple oxides, and a slurry containing ferrites and magnetites, a non toxic amount of leachable lead and a reduced amount of calcium;

c) separating the slurry and the supernatant liquid;

d) adding to the slurry obtained in step c) an anionic surfactant to disperse the ferrite particles adsorbed on the magnetite particles; and

e) treating the slurry from step d) to produce pigments selected from the group consisting of ferrite pigments, magnetite pigments and ferrite/magnetite pigments.

2. The process according to claim 1, wherein the sequence of steps a) to c) is performed more than one time before adding the anionic surfactant.

3. The process according to claim 1 or 2, wherein the solution obtained in step a) has a positive zeta potential, and the anionic surfactant is added in a concentration sufficient to reduce said zeta potential to or close to the isoelectric point.

4. The process according to claim 3, wherein said zeta potential is reduced to the isoelectric point.

5. The process according to any one of claims 1 to 4, wherein the anionic surfactant is a phosphate or an equivalent thereof.

6. The process according to any one of claims 1 to 5, wherein the anionic surfactant preferred is sodium metaphosphate.

7. The process according to any one of claims 1 to 6, wherein step e) of treating the slurry comprises the step of:

- magnetically separating the slurry into a first fraction composed essentially of brownish ferrites and a second fraction composed essentially of black magnetite, the first fraction being less magnetic than the second fraction.

8. The process according to claim 7, wherein the step of magnetic separation is performed with a magnetic field in the range of 400 to 700 gauss.

9. The process according to claim 8, wherein the magnetic field is around 550 gauss.

10. The process according to any one of claims 7 to 9, further comprising the step of:

-treating the first fraction to produce ferrite pigments.

11. The process according to claim 10, wherein the step of treating the first fraction comprises:

-removing from the first fraction, particles having a grain size of 20 µm or more, to obtain a refined first fraction

-leaching said refined first fraction with a solvent, to obtain a leached slurry;

-separating said leached slurry into a solid fraction containing ferrite pigments and a liquid fraction containing constituents of the first fraction soluble in said solvent; and

- drying said solid fraction to obtain dry pigments of ferrites.

12. The process according to claim 11, wherein the solvent is water and the ferrite pigments are ferrite pigments of a first grade.

13. The process according to claim 11, wherein the solvent is sulphuric acid, the leaching is performed at a pH of 0,5 to 3 and the ferrite pigments are ferrite pigments of a second grade.

14. The process according to claim 11, wherein the solvent is nitric acid, the leaching is performed at a pH of up to 3, and the ferrite pigments are ferrite pigments of a third grade.

15. The process according to claim 14, comprising the step of wet grinding the solid fraction to obtain a forth grade of pigments having a finer mean grain size and a lower concentration of lead as compared to the ferrite pigments of the third grade.

16. The process according to any one of claims 7 to 15, comprising the step of:

-treating the second fraction to produce magnetite pigments.

17. The process according to claim 16, wherein the step of treating the second fraction comprises the step of:

-screening at 6 μm to obtain a first finer fraction with particles having a grain size of 6 μm or less; and a coarser fraction with particles having a grain size greater than 6 μm.

18. The process according to claim 17, comprising the steps of

-milling said coarser fraction, and

-removing from the milled coarser fraction the particles having a grain size greater than 40 μm and returning said particles for further milling, and a second

finer fraction having particles with a grain size of less than 6 µm, resulting in said coarser fraction containing particles having a grain size between 40 and 6 µm.

19. The process according to claim 17 or 18, wherein it comprises the steps of:

- wet grinding by attrition the coarser fraction to attain a mean grain size of approximately 0,3 µm; and

-filtering and drying the grinded coarser fraction, to obtain a magnetite pigment of a first grade.

20. The process according to any claim 17 or 18, wherein it comprises the step of:

-purifying the first and second finer fractions by suspending residual contaminants contained therein with an anionic surfactant, to obtain a purified magnetic fraction;

-decanting the purified fraction;

- wet grinding by attrition the purified fraction; and

- filtering and drying the ground purified fraction, to obtain a magnetite pigment of a second grade.

21. The process according to claim 1 or 2, comprising the steps of:

-removing from the slurry obtained in step d), particles having a grain size of 60 µm or less, to obtain a refined slurry;

-leaching the refined slurry with nitric acid at a pH of about 3, to obtain a leached slurry with no or a controlled amount of ZnO which retard the setting of concrete;

-separating said leached slurry into a solid fraction containing a mixture of ferrite and magnetite pigments and a liquid fraction containing constituents soluble in nitric acid; and

- drying said solid fraction to obtain dry pigments containing a mixture of ferrite and magnetite.

22. A process according to any one of claims 10 to 21, comprising the steps of:
   -coating said pigments with an inorganic and/or organic coating; and
   -micronizing the coated pigments.

23. A ferrite pigment obtained by a process according to any one of claims 10 to 15.

24. A ferrite pigment from an EAF dust, wherein it shows a resistance to leaching.

25. A ferrite pigment according to claim 24, wherein it shows a color thermal stability at temperatures of 300°C and higher.

26. A ferrite pigment according to claims 24 or 25, wherein it provides anticorrosion properties to metallic paint formulation.

27. A magnetite pigment obtained by a process according to any one of claims 16 to 20.

28. A magnetite pigment, wherein it comes from an EAF dust.

30. Use of a ferrite pigment according to any one of claims 23 to 26 for incorporation in an anticorrosive paint formulation, plastic formulation or concrete formulation.

31. Use of a magnetite pigment as defined in claim 27 or 28, for incorporation in a paint formulation, plastic formulation or toner formulation to provide magnetic properties.